

## WIND.

The *prevailing winds* for November, 1896, viz, those that were recorded most frequently, are shown in Table I for the regular Weather Bureau stations.

The *resultant winds*, as deduced from the personal observations made at 8 a. m. and 8 p. m., are given in Table IX. These latter resultants are also shown graphically on Chart IV, where the small figure attached to each arrow shows the number of hours that this resultant prevailed, on the assumption that each of the morning and evening observations represents one hour's duration of a uniform wind of average velocity. These figures indicate the relative extent to which winds from different directions counterbalanced each other.

## HIGH WINDS.

*Maximum wind velocities* of 50 miles or more per hour were reported during this month at regular stations of the Weather Bureau as follows (maximum velocities are averages for five minutes; extreme velocities are gusts of shorter duration, and are not given in this table):

Stations.	Date.	Velocity.	Direction.	Stations.	Date.	Velocity.	Direction.
		Miles				Miles	
Amarillo, Tex.....	5	56	s.	Fort Canby, Wash.....	12	80*	s.
Do.....	26	52	w.	Do.....	13	66*	s.
Bismarck, N. Dak.....	26	54	nw.	Do.....	14	76	s.
Do.....	27	51	nw.	Do.....	30	58	se.
Buffalo, N. Y.....	5	66	w.	Huron, S. Dak.....	22	56	se.
Do.....	6	72	w.	New York, N. Y.....	5	52	se.
Do.....	11	56	s.	Do.....	14	50	nw.
Cairo, Ill.....	26	51	s.	Rapid City, S. Dak.....	16	54	sw.
Chicago, Ill.....	27	53	w.	Sault Ste. Marie, Mich.....	8	52	nw.
Detroit, Mich.....	5	52	sw.	Tatoosh Island, Wash.....	12	50	s.
Fort Canby, Wash.....	1	83	se.	Do.....	14	50	w.
Do.....	4	60	se.	Do.....	19	50	e.
Do.....	7	58	s.	Winnemucca, Nev.....	9	50	sw.
Do.....	8	58	s.	Woods Hole, Mass.....	15	52	sw.

## ATMOSPHERIC ELECTRICITY.

Numerical statistics relative to auroras and thunderstorms are given in Table X, which shows the number of stations from which meteorological reports were received, and the number of such stations reporting thunderstorms (T) and auroras (A) in each State and on each day of the month, respectively.

*Thunderstorms*.—The dates on which reports of thunderstorms for the whole country were most numerous were: 3d, 41; 12th, 53; 25th, 73; 26th, 45.

Thunderstorm reports were most numerous in: Illinois, 33; Louisiana, 36; Nebraska, 31; Tennessee, 37.

Thunderstorms were most frequent in: Illinois, 9 days; Louisiana, 13; Mississippi and Texas, 10.

*Auroras*.—The evenings on which bright moonlight must have interfered with observations of faint auroras are assumed to be the four preceding and following the date of full moon, viz, from the 15th to the 23d, inclusive. On the remaining twenty-one days of this month 52 reports were received, or an average of about 2.5 per day. The dates on which the number of reports especially exceeded this average were: 5th, 5; 6th, 12; 7th, 8.

Auroras were reported most frequently in: Massachusetts and Nebraska, 4 days; Ohio, 8; Wisconsin, 6.

The number of reports was a large percentage of the number of observers in: Delaware, 33; Rhode Island, 12; Wisconsin, 10; South Dakota, 7; Ohio, 6.

## CANADIAN REPORTS.

Thunderstorms were reported from Rockcliffe and Parry Sound on the 18th.

Auroras were reported as follows: Grindstone, Grand Manan, Charlottetown, Father Point, and Prince Albert, 7th; Minnedosa, 13th, 18th; Qu'Appelle, 19th, 20th; Medicine Hat, 8th; Swift Current, 22d; Battleford, 6th, 7th; Banff, 5th, 6th, 9th.

## CLIMATE AND CROP SERVICE.

By JAMES BERRY, Chief of Climate and Crop Service Division.

The following extracts relating to the general weather conditions in the several States and Territories are taken from the monthly reports of the respective services.

Snowfall and rainfall are expressed in inches.

*Alabama*.—The mean temperature was 57.6°, or 4.7° above normal; the highest was 90°, at Healing Springs on the 12th, and the lowest, 14°, at Hamilton on the 29th. The average precipitation was 4.20, or 0.36 above normal; the greatest monthly amount, 7.67, occurred at Elba, and the least, 0.54, at Pineapple. There has been rain sufficient to give navigable stages to the larger rivers, and the scarcity of water of October and preceding months is relieved to a great extent by the heavy showers of the first and latter part of the month.

*Arizona*.—The mean temperature was 55.2°, or 0.2° above normal; the highest was 98°, at Maricopa, and the lowest, 10°, at Holbrook on the 30th. The average precipitation was 0.73, or 0.12 below normal; the greatest monthly amount, 3.60, occurred at Maricopa; no rain fell at Casa Grande, 20 miles southeast of Maricopa.

*Arkansas*.—The mean temperature was 52.8°, or 2.9° above normal; the highest was 88°, at Picayune on the 10th and Elon on the 11th, and the lowest, 8°, at Keesees Ferry on the 30th. The average precipitation was 4.33, or normal; the greatest monthly amount, 9.51, occurred at Arkansas City, and the least, 1.26, at Fulton.

*California*.—The mean temperature was 52.1°, or 1.3° above normal; the highest was 97°, at Pomona on the 15th, and the lowest, 17° below zero, at Bodie on the 27th. The average precipitation was 4.39, or 1.96 above normal; the greatest monthly amount, 23.87, occurred at La Porte, in the mountain regions of Plumas County, and the least, "trace," at Needles, in the desert regions of San Bernardino County.

*Colorado*.—The month was marked by unusually high and low temperatures, the former occurring generally on the 15th and 16th east of the Continental Divide, and the latter from the 25th to the close of the month throughout the State. The highest was 83°, at Minneapolis

(in the southeastern section of the State) on the 16th, and the lowest, 25° below zero, at Breckenridge and Steamboat Springs on the 28th, and Hot Sulphur Springs on the 29th. The average precipitation was 0.69, or 0.09 below normal; the greatest monthly amount, 9.30, occurred at Ruby, while none fell at several stations.

*Florida*.—The mean temperature was 70.1°, or nearly 4.0° above normal; the highest was 90°, at Orange Park on the 3d and Plant City on the 12th, and the lowest, 34°, at Pensacola on the 30th. The average precipitation was 3.33, or 0.37 above normal; the greatest monthly amount, 13.17, occurred at Milton, and the least, 0.64, at Frostproof.

*Georgia*.—The mean temperature was 58.5°, or about 4.8° above normal; the highest was 85°, at Fleming on the 12th; the lowest, 22°, at Diamond and Ramsey on the 9th. The average precipitation was 5.72, or 2.62 above normal; the greatest monthly amount, 11.89, occurred at Clayton, and the least, 2.18, at Albany.

*Idaho*.—The mean temperature was 29.4°; the highest was 80°, at Payette on the 1st, and the lowest, 38° below zero, at Chesterfield on the 26th. The average precipitation was 3.75; the greatest monthly amount, 11.12, occurred at Murray, and the least, 0.73, at Burnside. The month opened with rainfall and mild temperatures in all parts of the State; these conditions were the rule, with slight variations, until the 26th, when a sudden and severe cold wave was experienced, accompanied by high winds and heavy snowfall; the month closed with intensely cold weather prevailing in all sections. At the end of the month the entire State, except the extreme southern section, was covered with snow in depths ranging from 2 to 22 inches, the latter being reported at Lake.

*Illinois*.—The mean temperature was 40.4°, or 1.3° above normal; the highest was 80°, at Mount Vernon on the 17th and Rose Hill on the 2d and 17th, and the lowest, 2° below zero, at La Harpe on the 28th and Scales Mound on the 30th. The average precipitation was 2.72, or 0.42 below normal; the greatest monthly amount, 6.92, occurred at Rose Hill, and the least, 0.65, at Reynolds.

*Indiana*.—The mean temperature was 44.2°, or 3.2° above normal;

the highest was 79°, at Washington on the 18th, and the lowest, 5°, at Lafayette on the 30th. The average precipitation was 3.24, or 0.52 below normal; the greatest monthly amount, 5.44, occurred at Worthington, and the least, 1.19, at Logansport.

**Iowa.**—The mean temperature was 29.6°, or 4.5° below normal; the highest was 82°, at Belknap on the 16th, and the lowest, 15° below zero, at Rock Rapids on the 30th. The average precipitation was 1.83, or 0.07 above normal; the greatest monthly amount, 4.51, occurred at Spencer, and the least, 0.16, at Atlantic.

**Kansas.**—The mean temperature was 37.7°, or 3.1° below normal; the highest was 82°, at Achilles on the 16th, and the lowest, 13° below zero at Norton on the 27th. The average precipitation was 0.92, or 0.01 above normal; the greatest monthly amount, 3.14, occurred at Columbus, and the least, "trace," at Fort Riley, Lakin, Phillipsburg, and Ulisses.

**Kentucky.**—The mean temperature was 49.3°, or 4.0° above normal; the highest was 80°, at Henderson and Russellville on the 18th, and Ashland on the 25th, and the lowest, 11°, at Richmond on the 30th. The average precipitation was 5.01, or 0.99 above normal; the greatest monthly amount, 6.98, at Caddo, and the least, 3.03, at Richmond. The weather throughout the month was favorable for all agricultural interests at this season. Excessive heat and well-distributed rains stimulated the growth of winter grain and kept the pastures fresh and green to an extent that is without precedent in November.

**Louisiana.**—The mean temperature was 61.8°, or 3.6° above normal; the highest was 92°, at Covington on the 19th, and the lowest, 20°, at Minden on the 29th. The average precipitation was 5.22, or 1.31 above normal; the greatest monthly amount, 9.78, occurred at Thibodeaux, and the least, 1.08, at Shreveport.

**Maryland.**—The mean temperature was 49.4°, or 6.0° above normal; the highest was 78°, at Millsboro on the 1st, Milford on the 28th, and Westernport on the 27th, and the lowest, 12°, at Sunnyside on the 30th. The average precipitation was 3.08, or 0.05 above normal; the greatest monthly amount, 6.92, occurred at Milford, and the least, 1.08, at Charlotte Hall School. Twenty-nine stations reported snowfall during the month, the amounts ranging from "trace" at McDonogh School to 6 inches at Darlington.

**Michigan.**—The mean temperature was 35.6°, or 0.6° above normal; the highest was 72°, at Grape on the 3d, and the lowest, 12° below zero, at Iron River on the 30th. The average precipitation was 3.47, or 0.57 above normal; the greatest monthly amount, 6.80, occurred at Gaylord, and the least, 1.36, at Thornville.

**Minnesota.**—The mean temperature was 18.0°, or 6.6° below normal; the highest was 67°, at La Crosse on the 16th, and the lowest, 39° below zero, at Tower on the 29th. The average precipitation was 2.69; the greatest monthly amount, 5.47, occurred at Worthington. The cold of November, 1880, was more severe than the cold of this month, but since then it has not been equaled, and records at Minneapolis show that aside from 1880, in only two years (1872 and 1875) has the cold been as great as this year, since 1864. On the 25th and 26th there was general and very heavy precipitation in the northern part of the country, as a severe blizzard in western and northern Minnesota and westward, and as heavy rain in the southeastern part of the State. After the passage of the "low," during the 26th, a cold wave set in, causing intense suffering in all sections and the loss of at least four lives in this State. Much loss of cattle will probably result, and also of unthrashed grain, of which there is considerable. Railroad traffic has been very seriously hindered, and at the close of the month several lines were not yet open.

**Mississippi.**—The mean temperature was 58.6°, or 5.0° above normal; the highest was 88°, at Magnolia, Natchez, and Yazoo City on the 11th, and Hazlehurst on the 12th; the lowest was 17°, at French Camp on the 9th. The average precipitation was 3.92, or 0.72 below normal; the greatest monthly amount, 8.13, occurred at Austin, and the least, 0.63, at Okolona.

**Missouri.**—The mean temperature was 42.3°, or 0.8° above normal; the highest was 82°, at Mount Vernon on the 15th, and the lowest, 5° below zero, at Maryville on the 30th. The average precipitation was 2.21, or 0.23 below normal; the greatest monthly amount, 6.80, occurred at Gayoso, and the least, 0.70, at Oregon.

**Montana.**—The mean temperature was 18.0°, or 11.0° below normal; the highest was 73°, at Wibaux on the 15th, and the lowest, 42° below zero, at Fort Logan on the 28th. The average precipitation was 2.40, or 0.25 above normal; the greatest monthly amount, 8.61, occurred at Libby, and the least, 0.90, at Chinook.

The month of November was remarkable. During the middle portion of the month warm weather was general over the State, with warm chinook winds. From the middle until the end of the month cold weather occurred, nothing like it having been known for the month of November in the history of the State. For days in succession the temperature registered below the zero point. The cold wave was accompanied by heavy snows, and in some sections high winds. The following remarks are furnished by observers:

**Butte:** Warm and partly cloudy weather up to the afternoon of the 17th, when a fall of snow, accompanied by high winds, occurred. The wind seemed to whirl in every direction. The snow lasted only a short

time, after which the temperature fell from 50° to 27°. The lowest temperature for the month was -24°.

**Choteau:** Up to the morning of the 16th the weather was about normal, with a light snowfall on the 9th. From the morning of the 16th until the close of the month weather conditions quite the reverse obtained. Snow to the depth of 10 inches in the next four days, with a minimum temperature of -30; near this point the temperature hovered until the end of the month. The weather was very severe on live stock, and, where it could not be fed, much suffering was sustained or threatened. The snow was much deeper 18 miles north of this station.

**Glendive:** Unless relief comes soon the loss of stock will be large. Many frozen sheep are thrown out of the yards every morning. The outlook is bad for sheep and cattle in this portion of the State.

**Great Falls:** On the 13th chinook winds began during the night and continued on the 14th, increasing in force, blowing directly from the southwest all day. On the 15th chinook winds continued up to about 12.25 p. m. when a sudden change in temperature, but not in direction of wind, which was from the same direction. Temperature fell in an incredibly short time from 44° to 23°. The cold blast seemed to have dropped from the sky without any noticeable change in wind direction. About 4.15 p. m. a sudden change took place bringing the temperature up to 54° from which point it fell gradually to 19° at sunset. Snow began during the night of the 16th, and fell at intervals until the 19th. Mr. Herzog is of the opinion "that the sudden changes in temperature are probably due to two currents of wind (upper and lower) of different temperatures, and that these currents change places and produce the waves. At times a chinook is preceded by a cold southwest wind, again it follows the chinook, then again a cold wave is suddenly experienced, lasting a short time when again the chinook prevails. Close observations fail to note any changes in wind direction, so that the modulation of the waves must be upward and downward."

**Havre:** The weather at this station during the latter portion of the month was a record breaker, so far as precipitation and temperature was concerned. With a minimum temperature of -32° on the morning of the 20th, and with temperatures below zero fourteen days in succession, the outlook is very discouraging to the stock interests. Snow covered the ground to a depth of 14 inches on the 26th, and a severe cold wave prevailed in this section until the end of the month.

**Helena:** Very high temperatures occurred from the 13th up to 7.45 a. m. of the 16th; at that hour the temperature registered 57° from which point a sudden fall, almost instantaneous, of 27° occurred. At 10 a. m. the temperature registered 17°. Extreme cold weather continued from the above date until the end of the month. On the morning of the 28th a minimum of -22° was recorded, this being the lowest on record for the month of November. The heavy snowfall interrupted street car traffic and train service. Cattlemen state that it is their opinion that the exceptional temperature conditions and the excessive snowfall during the month will result in some loss of stock, coming as it does so early in the season.

**Kipp:** The temperature on the 14th rose from -6° to 49° at 3 p. m. and remained at that point until 3.55 p. m., when the wind veered to the northeast and sleet began falling and continued until 4 p. m. of the 15th, then changing to a furious snowstorm. During the p. m. of the 14th heavy rain fell in the mountains, causing the streams to rise, flooding the lowlands, and drowning a great many cattle. On the night of the 17th 29 inches of snow remained on the ground.

**Nebraska.**—The mean temperature was 26.1°, or 8.8° below normal; the highest was 85°, at Beaver City on the 16th, and the lowest, 22° below zero, at Lodge Pole on the 27th. The average precipitation was 1.21, or 0.53 above normal; the greatest monthly amount, 3.85, occurred at Harrington, and the least, "trace," at several stations.

**Nevada.**—The mean temperature was 35.6°, or 2.0° below normal; the highest was 79°, at Downeyville on the 14th, and the lowest, 23° below zero, at Wells on the 27th. The average precipitation was 1.10, or 0.39 above normal; the greatest monthly amount, 4.29, occurred at Stoffel, and the least, "trace," at Candelaria.

**New England.**—The mean temperature was 42.0°, or 4.0° above normal; the highest was 74°, at Lake Cochituate, Mass., on the 17th, and the lowest, 11° below zero, at Fort Fairfield, Me., on the 23d. The average precipitation was 0.83 below normal; the greatest monthly amount, 6.05, occurred at Cohasset, Mass., and the least, 1.95, at Kineo, Me. This month will be recalled as excellent all previous Novembers as to mild weather. The average daily excess in temperature was 4°, and at some places the monthly mean was higher than the normal by more than 6°. At Boston the mean was the highest for this month since the establishment of the station in 1871, and the maximum temperature of 72° on the 27th broke the record for the third decade of the month. In fact, at nearly all the Weather Bureau stations in New England the monthly means were the highest ever noted in November, and the same may be safely said of many of the voluntary stations. The weather was favorable for all outdoor work. Grass was very green for the season; at Worcester, Mass., dandelions were in blossom. Winter grain will enter the coming season in good condition.

**New Jersey.**—The mean temperature was 48.2°, or 6.1° above normal; the highest was 83°, at Barnegat on the 2d, and the lowest, 12°, at Dover on the 23d. The average precipitation was 3.05, or 0.68 below

normal; the greatest monthly amount, 5.68, occurred at Charlotteburg, and the least, 1.37, at Barnegat.

**New Mexico.**—The highest temperature was 87°, at Eddy on the 18th, and the lowest, 19° below zero, at La Belle on the 29th. The precipitation was light throughout the Territory; the greatest monthly amount, 2.15, occurred at Chama; no precipitation fell at several stations.

**New York.**—The mean temperature was 42.4°, or 4.6° above normal; the highest was 76°, at Addison on the 18th, and the lowest, 1° below zero, at Canton and Saranac Lake on the 23d. The average precipitation was 2.83, or 0.14 below normal; the greatest monthly amount, 6.21, occurred at North Lake (Atwell P. O.), and the least, 0.60, at Tyrone. The unusually warm weather permitted plowing to be carried on even in most northern counties until the 28th.

**North Carolina.**—The mean temperature was 54.8°, or 5.1° above normal; the highest was 86°, at Newbern on the 12th, and the lowest, 15°, at Highlands on the 9th. The average precipitation was 4.67, or 1.33 above normal; the greatest monthly amount, 12.15, occurred at Horse Cove, and the least, 1.52, at Newbern. The month was remarkably mild and pleasant and the warmest November on record.

**North Dakota.**—The mean temperature was 8.1°, or 20.3° below normal; the highest was 62°, at Medora on the 15th, and the lowest, 32° below zero, at Fargo on the 29th and Hamilton on the 30th. The average precipitation was 2.23, or 1.75 above normal; the greatest monthly amount, 4.33, occurred at Mayville, and the least, 0.74, at Minto.

The temperature and precipitation departures were the greatest ever recorded since the establishment of the service, the former being 20° deficient, and the latter 1.75 inches in excess of the normal. The great storm that passed over the State on the 26th was one of the most severe, if not the most, that was ever experienced. Eight lives are now known to have been lost in it, and many more are reported as missing and have not as yet been accounted for, and owing to the sparsely settled condition of the State, as well as the fact that all roads are almost impassable, making communication very difficult, the particulars will not be known for a long time. While the loss of life was comparatively large, the loss of live stock will probably reach a very high figure, and as the ground is covered to a depth of nearly two feet with snow, it will be likely to cause more losses before spring.

**Ohio.**—The mean temperature was 45.1°, or 4.4° above normal; the highest was 79°, at Thurman on the 1st, Bellefontaine on the 5th, and Ripley on the 27th; and the lowest, 7°, at Orangeville on the 30th. The average precipitation was 2.63, or 0.4 below normal; the greatest monthly amount, 5.50, occurred at Fayette, and the least, 0.93, at Bellefontaine. Snow afforded but little protection to wheat during cold weather. Farm work made excellent progress and pastures are fairly good for time of year.

**Oklahoma.**—The mean temperature was 47.3°; the highest was 91°, at Norman on the 17th, and the lowest, zero, at Beaver on the 29th. The average precipitation was 1.83; the greatest monthly amount, 3.48, occurred at Burnett, and the least, 0.19, at Beaver. Generally, winter wheat is in first class condition, and is all, except very late planted, well matted over the ground, and in excellent shape for the winter.

**Oregon.**—The mean temperature was 38.6°, or 6.8° below the 5-year normal. In the coast district the mean temperatures ranged from 37° to 51°; in the Willamette Valley district from 35° to 40°; in the southern Oregon district from 40° to 43°, and in the eastern Oregon district from 27° to 38°. The greatest deficiency in temperature occurred in eastern Oregon; the highest temperature was 71°, at Pendleton on the 15th; the lowest was 32° below zero, at Silver Lake on the 26th and 27th, or 33° lower than the next lowest November temperature ever reported since 1888. The average precipitation for the State was 12.64, or 7.30 more than the normal. The monthly amounts ranged from 12 to 39 inches in the coast district; from 11 to 20 inches in the Willamette Valley district; from 5 to 10 inches in the southern Oregon district, and from 1 to 24 inches in the eastern Oregon district. All previous precipitation records were broken this month. Glenora reported 7.68 inches of rain on the 13th. Snow fell in all parts of the State, except a few places on the immediate coast. The snowfall ranged from 0.2 inch to 9.5 inches in western Oregon and from 0.5 inch to 44.5 inches in eastern Oregon. The mountain station at Government Camp (7,000 feet elevation) reported 74.0 inches of snow during the month. Briefly, November, 1896, in Oregon, was a phenomenal month, all records of temperature, precipitation, wind, and height of rivers having been broken. The weather was unfavorable to fall plowing and seeding. The great freezeup on the 27-29th greatly damaged the potato crops, which will be considerably short of the average by next spring. On the other hand, the extreme cold was beneficial to fruit trees and resulted in the extermination to a great extent of all manner of pestiferous insects.

**Pennsylvania.**—The mean temperature was 46.0°, or 6.0° above normal; the highest was 83°, at Confluence on the 28th, and the lowest, 12°, at Blooming Grove on the 23d. The average precipitation was 3.55, or 0.32 above normal; the greatest monthly amount, 8.05, occurred at Girardville, and the least, 0.82, at Wellsboro.

**South Carolina.**—The mean temperature was 59.1°, or 4.7° above normal; the highest was 90°, at Cheraw on the 12th, and the lowest, 26°, at Clemson College on the 9th. The average precipitation was 4.00, or

1.39 above normal; the greatest monthly amount, 9.48, occurred at Greenville, and the least, 1.12, at St. Matthews.

**South Dakota.**—The mean temperature was 16.5°, or 17.2° below normal; the highest was 70°, at Oelrichs and Rapid City on the 16th, and the lowest, 29° below zero, at Webster on the 30th. The average precipitation was 1.55, or 1.07 above normal; the greatest monthly amount, 2.88, occurred at Mellette, and the least, 0.45, at Chamberlain.

The month was an unusually cold one and was really a winter month all through. Although in some former years the minimum temperature has been lower the average daily temperature during this November continued persistently low most of the time. The principal meteorological feature of the month, other than the unusually low temperature, was the storm of the 25th, 26th, 27th. This storm started in most localities with rain and sleet, turning to snow, with high northerly winds. It began on the 25th and continued until the 27th. During the day and night of 26th it developed into a severe winter storm of snow and high wind, especially over the north, northeast, west, and southwest portions of the State. It was compared in many localities with the storm of January 12, 1888, but so far as can be learned the wind was not near so high, generally, and the temperature did not reach so low a point. The sleet on the 26th was extraordinarily heavy in the east and southeast portions of the State, and it is reported that in many localities its weight stripped some of the trees of most of the smaller branches and limbs. Telegraph lines were prostrated in all directions and in many places the poles were broken off. While there is very little loss of live stock reported from sections where shelter was available it is reported that there were some heavy individual losses on the ranges. The death of several persons is also reported from the ranges west of the Missouri River, who were out with stock and became lost in the storm. As near as can be learned the sleet of the 26th was the heaviest known in the east and southeast portion of the State.

**Tennessee.**—The mean temperature was 51.5°, or 3.8° above normal; the highest was 80°, at Dyersburg on the 1st, and the lowest, 13°, at Jacksonville on the 9th. The average precipitation was 6.56, or 2.66 above normal; the greatest monthly amount, 9.76, occurred at Molino, and the least, 3.79, at Springdale.

**Utah.**—The mean temperature was 33.4°; the highest was 78°, at St. George on the 15th, and the lowest, 20° below zero, at Soldier Summit on the 12th. The average precipitation was 1.23; the greatest monthly amount, 3.49, occurred at Huntsville, and the least, "trace," at Giles.

**Virginia.**—The mean temperature was 51.3°, or 4.0° above normal; the highest was 83°, at Bonair and Nottoway on the 18th, and the lowest, 10°, at Hot Springs on the 30th. The average precipitation was 3.84, or 1.36 above normal; the greatest monthly amount, 6.16, occurred at Burke's Garden, and the least, 1.96, at Birdsnest.

**Washington.**—The mean temperature was 33.8°, or 8.0° below normal; the highest was 73°, at Kennewick on the 15th, and the lowest, 29° below zero, at Ellensburg on the 28th. The average precipitation was 9.16, or 3.81 above normal; the greatest monthly amount, 19.39, occurred at Union City, and the least, 1.49, at Sunnyside. In more ways than one it was the most remarkable November weather in the memory of the oldest inhabitant. The cold spell from the 25th to the 30th was such a severe one as has never been known in November before, either by the whites, or by their predecessors, the Siwash. It has rarely been equaled even in midwinter. In all parts of the State east of the Cascades, and in some parts west of them the temperature fell below zero. The rainfall was entirely unprecedented during the first two weeks, and in conjunction with the warm wave, or chinook winds which culminated on the 13th, caused the highest floods in the rivers flowing west of the Cascades ever known by the white settlers.

**West Virginia.**—The mean temperature was 48.1°, or about 4.0° above normal; the highest was 80°, at Philippi on the 2d, and the lowest, 10°, at Bluefield on the 30th. The average precipitation was 3.50, or 0.25 above normal; the greatest monthly amount, 5.07, occurred at White Sulphur Springs, and the least, 1.56, at Bloomery.

**Wisconsin.**—The average temperature for the month of November was 28°, which is 2.8° below normal. The greatest deficiency in temperature occurred in the northwestern section of the State and ranged from 5° to 10° daily. The average temperature in the northern portion of the State was 23.4°, which is 3.8° below the November normal for that section. The average temperature for the central portion of the State was 27.7°, or 2.5° below normal, while for the southern section the average temperature, 32.8°, was slightly higher than normal. The highest temperature for the month occurred generally on the 16th, but during the latter part of the month another warm wave passed over the State, resulting in temperatures nearly as high as those occurring on the 16th. On the 26th a cyclonic storm of marked energy passed over the State; the temperature rose very rapidly, reaching a remarkable height. At Milwaukee on the 26th the temperature reached 61°, which is 3° higher than any previous record for the last ten days of November since the establishment of the Weather Bureau in this State. Equally high temperatures were reported from other portions of the State on this date. The abnormal heat was followed by the opposite extreme, and when the storm center had passed eastward so as to bring Wisconsin within the sweep of

the northerly winds of the approaching anticyclone, the temperature fell with great rapidity, reaching the zero mark at nearly all stations in the central and northern sections by the morning of the 23th. The cold wave was remarkable for its persistency, and the temperature continued to fall during the remaining days of the month, generally reaching the lowest point on the 30th. The rapidity with which the temperature fell on the approach of the cold wave was remarkable, as is indicated by the following twenty-four hour changes: At Boscobel the temperature fell 55°; Crandon, 61°; Waukesha, 52°; Gratoit, 61°, and Madison, 50°. The lowest temperature reported in the State was 18° below zero, at Hayward on the 22d.

The average precipitation for the entire State was 2.87 inches, which is 0.98 of an inch in excess of the November normal. The average amount and departure from the normal, by sections, is as follows: Northern section, 3.91, an excess of 1.79; middle section, 2.76, excess, 1.09; southern section, 1.92, excess, 0.05. It will be noted that the heaviest precipitation occurred in the northern section, and the amount gradually decreased toward the southern portion of the State. The

heaviest precipitation for the month was 6.74 inches, at Appollonia, 5.00 inches of which fell during the storm of the 25th and 26th. The recent floods in the Chippewa Valley were undoubtedly due largely to the excessive rains which accompanied this storm, and a careful examination of the records of those stations located about the headwaters of that stream would indicate that the average amount of precipitation over the districts drained by the Chippewa River was about 2.00 inches during the continuance of the storm. This amount of precipitation would of itself be sufficient to raise the river to a high stage, but not sufficient to produce a destructive flood, and had the river been free from ice there is every reason to believe that the channel is amply sufficient to have carried off the water without doing any damage to the lowlands along its border.

*Wyoming.*—The mean temperature was 23.7°, or 7.0° below normal; the highest was 72°, at Sheridan on the 15th, and the lowest, 31° below zero, at Lander on the 27th. The average precipitation was 1.06, or 0.50 above normal; the greatest monthly amount, 3.92, occurred at Fort Yellowstone, and the least, 0.09, at Laramie.

## RIVER AND FLOOD SERVICE.

By PARK MORRILL, Forecast Official, in charge of River and Flood Service.

The *extreme and average stages of water* in the rivers for the current month are given in Table VIII. Flood waters have occurred only in the rivers of Oregon. Moderate rises took place in the California streams, and similar rises were caused by the heavy rains which fell in the Appalachian Mountain regions at intervals during the month. The northern Mississippi and Missouri and smaller tributary streams in the Dakotas, Minnesota, Wisconsin, and Iowa are frozen. The following résumé of river stages and conditions of navigation in the various streams is compiled from the reports of the various section directors of the River and Flood Service:

*Hudson River.*—The local storms on the upper Hudson watershed during the 6th, caused a 10-foot rise in the river at Troy, and an 8-foot rise at Albany. No damage was caused by high water during the month. The amount of water flowing into the Hudson was below the normal for the month of November, but the storm tides due to the passage of storms along the coast, together with the large percentage of southerly winds, which retarded the flow, kept the volume of water in the river from Coxsackie to Troy about normal.

*Susquehanna River and Branches.*—The general rains on the 4th and 5th caused a rise in all rivers of the watershed, the greatest rise noted on the West Branch being 5.5 feet at Williamsport, where the highest stage recorded was 7.5 feet on the 6th, and 6.0 feet at East Bloomsburg, on the North Branch, where the highest stage was 7.0 feet on the 6th; at Harrisburg the river rose 5.4 feet on the 6th and 2.9 on the 7th, the highest water reached being 10.1 feet on the 7th. Along the Juniata the rainfall on the 4th to 6th averaged between 2 and 3 inches, causing a rise of 2.4 feet at Huntingdon and 8.8 feet at Mifflin. After the 7th the streams fell gradually until near the end of the month, when they rose slowly in consequence of the showers that fell in the drainage basin of the Susquehanna. The water at no time during the month approached the danger line. The culm which came down with the rise on the 6th and 7th, as usual in such cases, discolored the Susquehanna and caused considerable annoyance to consumers of river water.

*Rivers of the South Atlantic States.*—These streams have been moderately low throughout the month, although a slight rise was occasioned by the rains of the 5th. On the 29th, rain, varying in amount from 0.50 to 1.50 inches, fell in the great valley and middle district of Virginia, and slightly less in eastern Virginia. A rapid, though moderate, rise in the James took place, but at no time caused any apprehension. The ground was very dry, owing to the previous lack of moisture, and a large portion of the precipitation was absorbed by the earth; hence the quantity reaching the river was materially lessened.

The Cape Fear River remained low during the month, except that a rise of 10 to 15 feet occurred on the 6th and 7th, but this did not bring the stage of the river more than half way to the danger line. For the remainder of the month the rivers in eastern North Carolina were quite low. In the mountainous western sections, owing to heavy rains, the streams maintained relatively high stages, except during the latter part of the month.

The logging interests in South Carolina have suffered during the month of November, owing to the unprecedentedly low stages of water in the streams. The Wateree was navigable from the 5th to the 14th only, when a number of rafts were successfully floated downstream. The rise also proved highly beneficial to the steamboat interests, much cotton, tar, rosin, turpentine, and general merchandise being carried

down. The Pedee was navigable from the 6th to the 10th between Georgetown and Cheraw. A large amount of merchandise is now awaiting transportation from Cheraw and points below for lack of a sufficient rise. The Santee was navigable from the 8th to the 22d. The Waccamaw and its branches were navigable from the 5th to the 13th from Georgetown to Effingham, Fair Bluff, and Conway, and, therefore, afforded steamboatmen and lumbermen a fair season for transportation. The Edisto was at a very low stage, and navigation thereon was suspended nearly the entire month, and no logging or steamboating was done at all, although millions of feet of lumber and much merchandise are awaiting transportation. A result of the deficient rainfall in the Piedmont region is the substitution by the owners of the cotton mills in those sections, of steam power for the hitherto unailing water supply. This lack of water is the first occurrence of this sort in twenty-four years. Quite a number of mills have ceased operations entirely for the want of power.

No very noticeable change occurred in the condition of the Savannah River, excepting on two occasions, when a considerable rise took place. The first rise occurred on the 6th, bringing the river up to 20.9 feet at Augusta, and, while facilitating the running of boats between that point and Savannah, was also highly beneficial to the farming interests of the lowlands, by leaving a deposit or sediment over the soil at a time when the fields are not in cultivation. The next rise occurred on the 14th, when the river reached a stage of 13.4 feet at Augusta, and materially aided flat boat traffic in handling produce and cotton. The lowest stage during the month was recorded on the 1st (5.0 feet at Augusta), which at this season of the year is hardly sufficient for rapid navigation, as large shipments of cotton are scattered along the river course for at least 75 miles below Augusta to be conveyed by boat to that market.

Several heavy rains fell on the Georgia watersheds which drain into the Altamaha and Apalachicola rivers. Resultant rises of from 5 to 10 feet were experienced at the various river stations on these streams. The stages were far below the danger line throughout the month.

*Mobile River and Branches.*—The Tombigbee River and its tributaries have been unusually low, remaining, for the most part, below the zero of the gauges; at Demopolis, on the Tombigbee, the stage did not rise above zero throughout the month. The rain, which was light and scattered, did but little to improve the prevailing unfavorable conditions. The rivers fell generally during the latter part of the month, giving unusually low stages, almost suspending traffic. General rain on the last three days of the month was of vast benefit in relieving this condition, and the rivers rose rapidly, opening navigation to all points, and this has continued to the end of the month. River men report that since May 1 no boat has been above Demopolis, and for the past three months not above Gays Landing, 60 miles below Demopolis. The rivers have been lower this year than for the three seasons past.

The Alabama and tributaries were all low during the first half of the month, with slight increase of water to navigable stages during the latter portion. At Montgomery the extremes varied from 0.5 feet below zero on the 3d to 7.5 feet above on the 14th, the fluctuations being slightly greater at Selma and less at upper river stations. The water has been too low for regular steamer navigation above Selma since the latter part of July. The first boat to arrive at Montgomery since the low season was the steamer *Tinsie Moore* from Mobile on November 19, which carried down over 1,000 bales of cotton and general freight.

*Ohio River and Branches.*—At Pittsburg the month has been one of exceptional activity for the river interests. For the first time in four years the river has remained open for packet navigation during the entire month. There was a barge-water stage on the 7th and 8th, and